2636. Distinguishing Pertussis from Viral Mimickers: Development and Validation of a Clinical Prediction Score

Lamya Al-Barwani, MD[1]; Muna Al-Busaidi, MD[1];
Zaid Alhinai, MD FAAP FPIDS[2]; Naema Al-Shibli, MD, MRCPCH[3]; [1]Oman Medical Specialty board, Muscat, Masqat, Oman; [2]Sultan Qaboos University, Muscat, Masqat, Oman; [3]Sultan Qaboos University Hospital, Muscat, Masqat, Oman

Session: 271. Pediatric Respiratory Viral Infections
Saturday, October 5, 2019: 12:15 PM

Background: Pertussis is often confused with respiratory viral infections, leading to misdiagnosis and overuse of antibiotics. Distinguishing the two entities more accurately can help optimize care.

Methods: We reviewed the charts of children under 18 years of age who presented to Sultan Qaboos University Hospital in Muscat, Oman and were tested for *Bordetella pertussis* by PCR between 2013 and 2018 (discovery cohort). Clinical and laboratory data were collected from the electronic patient record and analyzed. Backward conditional logistic regression was used to identify independent predictors of laboratory-confirmed pertussis cases. The Muscat Pertussis Index (MPI) score was developed based on the logistic regression model. The MPI score was retrospectively validated on a separate cohort of pediatric patients who presented to the Royal Hospital- Oman's largest pediatric center- between 2017 and 2018, and were similarly tested for pertussis (validation cohort). Ethical approval of the study was obtained formally for both sites.

Results: 354 patients were enrolled in the discovery cohort. 196 (55%) were male, and the median age was 10 weeks (IQR, 6–16). 57 (16%) patients tested positive for *B. pertussis* by PCR, while 266 (75%) tested positive for respiratory viruses. 32 (9%) patients had both pertussis and a viral co-infection and 63 (18%) were negative for both. 255 (72%) patients received macrolide antibiotics. Younger age, fewer vaccine doses, contact with a sick adult, longer symptom duration, paroxysmal cough, cyanosis, post-tussive emesis, apnea, lymphocytosis and thrombocytosis were significantly associated with pertussis (Table 1). After logistic regression, independent predictors of pertussis were longer symptom duration, lymphocytosis, paroxysmal cough, lack of fever, cyanosis and age under 8 weeks. This formed the basis for creating the MPI score (Table 2). The MPI score was validated on a cohort of 122 patients. Higher MPI scores correlated significantly with confirmed pertussis cases (area under the receiver operating characteristics curve = 0.899, $P < 0.001$, Figure 1 and Table 3).

Conclusion: The majority of suspected pertussis cases were actually due to viral mimickers. The MPI score can predict likely cases of pertussis before laboratory confirmation. Future validation in more diverse settings would help expand its applicability.

Table 1- Clinical and laboratory characteristics for pertussis positive and pertussis negative cases.

Characteristic	Pertussis PCR positive, n = 57	Pertussis PCR negative, n = 297	P value	Missing
Age, weeks, median (IQR)	8 (6-12)	11 (6-20)	**0.011**	1
Weight, kg, median (IQR)	4.4 (4.0-5.3)	4.8 (3.8-5.9)	0.212	0
Male gender, n (%)	32 (56%)	164 (55%)	0.898	0
Prematurity, n (%)	3 (6%)	70 (24%)	**0.002**	8
Duration of symptoms, days, median (IQR)	9 (7-21)	5 (3-8)	**<0.001**	3
Exposures				
Child sick contact, n (%)	10 (31%)	79 (66%)	**<0.001**	203
Adult sick contact, n (%)	23 (70%)	32 (27%)	**<0.001**	203
Symptoms				
Paroxysmal cough, n (%)	51 (90%)	203 (69%)	**0.001**	2
Post-tussive emesis, n (%)	32 (56%)	105 (36%)	**0.004**	2
Apnea, n (%)	24 (42%)	72 (24%)	**0.006**	1
Cyanosis, n (%)	29 (51%)	73 (25%)	**<0.001**	1
Fever, n (%)	18 (36%)	158 (53%)	**0.003**	1
Positive respiratory viral screen, n (%)	32 (62%)	234 (79%)	**0.007**	5
Rhinovirus, n (%)	24 (46%)	103 (35%)	0.117	6
RSV, n (%)	3 (6%)	122 (41%)	**<0.001**	6
Adenovirus, n (%)	3 (6%)	29 (10%)	0.445	6
Parainfluenza, n (%)	3 (6%)	24 (8%)	0.780	6
Enterovirus, n (%)	4 (8%)	11 (4%)	0.255	6
Influenza A, n (%)	1 (2%)	6 (2%)	1	6
Pertussis vaccine doses received				
No doses, n (%)	30 (59%)	104 (37%)	**0.004**	24
One dose, n (%)	13 (25%)	95 (34%)	0.231	24
Two doses, n (%)	5 (10%)	38 (14%)	0.651	24
Three doses, n (%)	1 (2%)	40 (14%)	**0.010**	24
Laboratory results				
WBC, 10^9/L, median (IQR)	18.6 (12.4-24)	11.3 (9.0-14.4)	**<0.001**	13
Lymphocytes, 10^9/L, median (IQR)	12.1 (8.8-18.4)	6.1 (4.3-8.2)	**<0.001**	13
Platelets, 10^9/L, mean (95% CI)	553 (456-612)	452 (342-582)	**<0.001**	14
C-reactive protein, mg/L, median (IQR)	0 (0-11.5)	6 (2-21)	**0.001**	74
Admission location (highest level)				
Not admitted, n (%)	10 (18%)	32 (11%)	0.151	1
Regular ward, n (%)	32 (56%)	163 (55%)	0.881	1
High dependency ward, n (%)	12 (21%)	70 (24%)	0.671	1
PICU, n (%)	3 (5%)	10 (10%)	0.325	1
Macrolide given, n (%)	56 (98%)	199 (68%)	**<0.001**	5
Respiratory support				
Room air, n (%)	41 (72%)	164 (55%)	**0.021**	1
Oxygen via mask or nasal cannula, n (%)	14 (25%)	86 (29%)	0.491	1
Non-invasive ventilation, n (%)	1 (2%)	30 (10%)	**0.040**	1
Invasive ventilation, n (%)	2 (4%)	16 (5%)	0.749	1
Length of stay, days, median (IQR)	4 (2-6)	4 (2-7)	0.341	0

Table 2- Calculating the MPI score

Criteria	Assigned score
Age	
≤ 8 weeks	+2
9 – 16 weeks	+1
Duration of Symptoms	
≥ 14 days	+2
7 – 13 days	+1
Coughing paroxysms	+1
Cyanosis	+1
Fever	-1
Absolute lymphocyte count	
≥ 14	+4
10 – 13	+3
6 – 9	+2
Maximum score	10

Table 3- Sensitivity, specificity, positive and negative likelihood ratios, and positive and negative predictive values for the MPI score in the validation study (assuming a 16% prevalence rate among patients tested for pertussis).

Criterion	Sensitivity (%)	Specificity (%)	+LR	-LR	+PV (%)	-PV (%)
≥-1	100	0	1		16	
>-1	100	1	1.0	0	16	100
>0	100	4	1.0	0	17	100
>1	100	10	1.1	0	17	100
>2	100	31	1.5	0	22	100
>3	93	56	2.1	0.13	28	98
>4	90	69	2.9	0.14	36	97
>5	80	83	4.7	0.24	47	96
>6	63	96	17	0.38	77	93
>7	37	99	30	0.64	85	89
>8	7	100		0.93	100	85
>9	2	100		0.98	100	84
>10	0	100		1		84

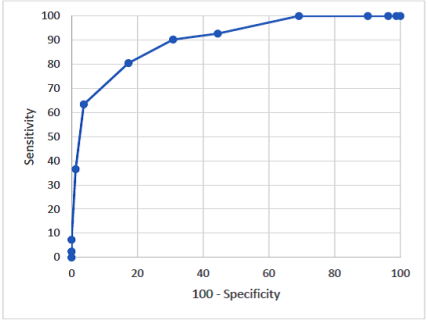

Figure 1 - Receiver operating characteristic curve for the MPI in the validation study. AUC = 0.899 (95% CI, 0.832 to 0.946, P < 0.001)

Disclosures. **All authors:** No reported disclosures.

2637. Third Trimester Immunization with an Respiratory Syncytial Virus F Protein Vaccine for the Prevention of RSV Lower Respiratory Tract Infection in Infants

Louis F. Fries, III, MD; Iksung Cho, MS; D. Nigel Thomas, PhD;
Judy L. Wen; Michelle S. Spindler, MS, CCRA; Amy B. Fix, MS, MBA, RAC;
Joyce S. Plested, PhD; Chang-Min Chen, MS; Gregory M. Glenn, MD; Novavax, Inc., Gaithersburg, Maryland

Session: 272. Studies of Treatment and Prevention of Viral Disease
Saturday, October 5, 2019: 12:15 PM

Background: Respiratory syncytial virus (RSV) is the leading viral cause of severe lower respiratory tract infection (LRTI) in infants worldwide, with severe disease

occurring in the first months of life. We assessed the efficacy of maternal immunization with an RSV F protein vaccine against RSV LRTI over the first 180 days of life.

Methods: We enrolled 4,636 women with low-risk third trimester singleton pregnancies in 11 countries to receive RSV F vaccine or placebo in a randomized, observer-blind trial. Women were followed for 6 months post-delivery, and infants for ~1 year. Surveillance for RSV LRTI in infants, identified by RT–PCR detection of RSV, physical examination, and pulse oximetry, was carried out for 180 days from delivery.

Results: The RSV F vaccine induced modest reactogenicity and no excess fever. Live births resulted from 98.7% of pregnancies, with no difference between treatment groups in prematurity (< 37 weeks) or mean interval from treatment to delivery. There were no apparent negative impacts on pregnancy, delivery, or infant well-being. Vaccine immunogenicity resembled that in non-pregnant women. Transplacental transfer of vaccine-induced antibodies was markedly more efficient when the interval from immunization to delivery was ≥30 days. 85 to 95% of primary and secondary endpoint RSV LRTI events in the placebo group occurred in the first 90 days of life (see Figure 1). Overall, through 180 days of infant life, RSV was associated with 11.3% of all acute respiratory illnesses and 16.7% of all LRTI, but 49.1% of LRTI with SpO_2 < 95% or tachypnea, and 60.3% of all LRTI with SpO_2 < 92% in the placebo group. Vaccine efficacy was greatest in the first 75 days of life but clearly persisted to the primary, per-protocol analysis at 90 days, and was supported by the ITT analysis, per Table 1. Efficacy against *all-cause* LRTI with severe hypoxemia (46.0%) or hospitalization (27.8%) was observed in the per-protocol population, as well as an apparent impact on the clinical diagnosis of pneumonia through both 180 and 364 days.

Conclusion: RSV F vaccine in the third trimester was safe and had clinically-meaningful impacts on RSV and all-cause LRTI over the first 6 months of life.

Figure 1: Cumulative Proportions of Placebo and Vaccine Infants with Medically Signficant (Tachypnea or SpO_2 <95%) or Severe (SpO_2 <92%) RSV LRTI

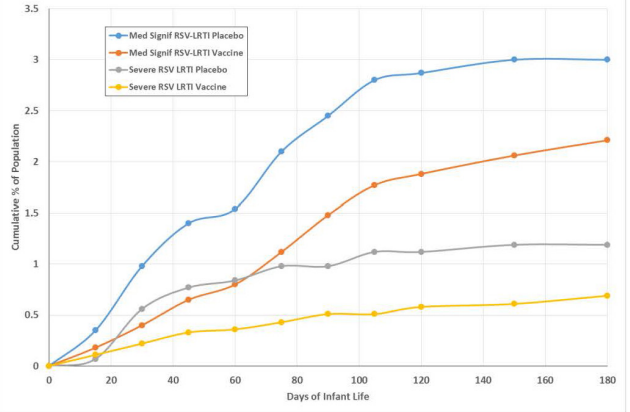

Table 1:

Efficacy of Maternal Immunization with RSV F Vaccine against LRTI Endpoints in Infants					
	Per-protocol population			Intent-to-Treat population	
Endpoint	Point estimate	95% CI	97.52% CI	Point estimate	95% CI
Medically significant RSV LRTI (SpO_2 <95% or tachypnea)	39.4%	5.3, 61.2%	-1.0, 63.7%	32.2	- 4.2, 55.9%
RSV LRTI with severe hypoxemia (SpO_2 <92%)	48.2%	-8.3, 75.3%	ND	44.4%	-14.9, 73.1%
RSV LRTI with hospitalization	44.4%	19.6, 61.5%	ND	48.1%	26.1, 63.5%

Disclosures. **All authors:** No reported disclosures.

2638. Respiratory Syncitial Virus Hospitalizations (RSVH) and All-Cause Bronchiolitis Hospitalizations (BH) Among 29–34 Weeks Gestational Age (wGA) Preterm Infants Before and After the 2014 American Academy of Pediatrics (AAP) Immunoprophylaxis Policy Change Using the Children's Hospital Association's Pediatric Health Information System (PHIS)

Jaime Fergie, MD[1]; Tara Gonzales, MD[2]; Xiaohui Jiang, MS[3]; Jon Fryzek, PhD, MPH[3]; [1]Infectious Disease, Driscoll Children's Hospital, Corpus Christi, Texas; [2]Sobi, Inc., Waltham, Massachusetts; [3]EpidStrategies, A Division of ToxStrategies, Inc., Rockville, Maryland

Session: 272. Studies of Treatment and Prevention of Viral Disease
Saturday, October 5, 2019: 12:15 PM

Background: In 2014, the AAP stopped recommending RSV immunoprophylaxis for otherwise healthy 29–34 wGA preterm infants. This study examined the risk of RSVH and BH among 29–34 wGA infants before the AAP policy change (November 1, 2010–March 31, 2014) and after (November 1, 2014–March 31, 2017) using PHIS hospital-level encounter data from 51 US children's hospitals.

Methods: The study population included the first November to March RSVH (ICD9 = 79.6, 480.1, 466.11, ICD10 = B97.4, J12.1, J21.0) or BH (RSVH or unspecified bronchiolitis [ICD9 = 466.19, ICD10 = J21.1, J21.8, J21.9]) among infants 6 months of age or younger admitted to a PHIS hospital between November 1, 2010 and March 31, 2017. The proportion of RSVH and BH by wGA categories (22–28 wGA, 29–34 wGA, 35–36 wGA, and term infants [37+ wGA]) were compared in the time period before and after 2014. Frequencies and proportions were calculated overall for all infants and by demographic and clinical factors for 29–34 wGA infants for RSVH and BH, separately. Statistically significant differences before and after the AAP policy were compared using χ^2 test or Wilcoxon rank-sum test, as appropriate.

Results: 96,281 infants with BH, including 67,570 with RSVH, were studied. Among infants with known gestational age, the proportions of hospitalizations for RSVH and BH increased after the AAP policy change for all wGA categories, except for term infants (table). Infants 29–34 wGA represented 8.7% of all RSVH before the policy change and 14.2% of all RSVH after the policy change ($P < 0.0001$). No significant differences were found by gender or co-morbidity for infants 29–34 wGA. Among infants 29–34 wGA, the intensive care unit admission rate increased significantly for RSVH (from 54.5% to 64.2%, $P < 0.0001$) and BH (from 46.7% to 54.5%, $P < 0.0001$) after the policy change. The median RSVH length of stay (from 6 to 7 days, $P = 0.047$) and median adjusted estimated cost (from $14,077 to $16,058, $P = 0.038$) increased significantly after the policy change.

Conclusion: RSV and all-cause bronchiolitis hospitalizations and their severity increased among preterm infants 29–34 wGA in the 3-year period following the 2014 AAP policy change on RSV immunoprophylaxis.

Table. Proportion of RSVH and BH by wGA

	RSV hospitalizations					All-cause bronchiolitis hospitalizations				
	11/1/2010-3/31/2014		11/1/2014-3/31/2017		P-value	11/1/2010-3/31/2014		11/1/2014-3/31/2017		p-value
	N	%	N	%		N	%	N	%	
22-28 wGA	233	1.9	243	2.3	0.052	505	3.0	591	3.6	0.001
29-34 wGA	1061	8.7	1524	14.2	<0.0001	1661	9.8	2270	13.9	<0.0001
35-36 wGA	1692	13.8	1503	14.0	0.624	2283	13.4	2201	13.5	0.785
37+ wGA	9253	75.6	7428	69.4	<0.0001	12563	73.8	11215	68.9	<0.0001
All	12239	100.0	10698	100.0		17012	100.0	16277	100.0	

Disclosures. **All authors:** No reported disclosures.

2639. Respiratory Virus Detections in Asthma-Related Pediatric Hospitalizations: New Vaccine Surveillance Network, United States

Claire Midgley, PhD[1]; Brian Rha, MD, MSPH[1]; Joana Y. Lively, MPH[1]; Angela P. Campbell, MD, MPH[1]; Julie A. Boom, MD[2]; Parvin H. Azimi, MD[3]; Geoffrey A. Weinberg, MD[4]; Mary. A. Staat, MD, MPH[5]; Natasha B. Halasa, MD, MPH[6]; Rangaraj Selvarangan, BVSc, PhD[7]; Janet A. Englund, MD[8]; Eileen J. Klein, MD, MPH[9]; Christopher J. Harrison, MD[10]; John V. Williams, MD[11]; Elizabeth P. Schlaudecker, MD, MPH[12]; Peter G. Szilagyi, MD, MPH[13]; Monica Nayakwadi Singer, MD, MPH[14]; Leila C. Sahni, PhD, MPH[15]; Aaron Curns, MPH[16]; Daniel C. Payne, PhD, MSPH[17]; Gayle Langley, MD, MPH[18]; Gayle Langley, MD, MPH[18]; John Watson, MD, MSc[18]; Susan I. Gerber, MD[1]; [1]Centers for Disease Control and Prevention, Atlanta, Georgia; [2]Baylor College of Medicine, Texas Children's Hospital, Houston, Texas; [3]UCSF, Berkeley, California; [4]University of Rochester School of Medicine & Dentistry, Rochester, New York; [5]Cincinnati Children's Hospital Medical Center, University of CIncinnati College of Medicine, Cincinnati, Ohio; [6]Vanderbilt University Medical Center, Nashville, Tennessee; [7]Children's Mercy, Kansas City, Missouri; [8]Seattle Children's Hospital/University of Washington, Seattle, Washington; [9]Seattle Children's Hospital, Seattle, Washington, [10]Children's Mercy Hospital, Kansas City, Missouri, [11]University of Pittsburgh, Pittsburgh, Pennsylvania, [12]Cincinnati Children's Hospital Medical Center, University of Cincinnati College of Medicine, Cincinnati, Ohio, [13]University of California, Los Angeles, Los Angeles, California, [14]UCSF Benioff Children's Hospital Oakland, Lafayette, California, [15]Texas Children's Hospital, Houston, Texas, [16]Division of Viral Diseases, Centers for Disease Control and Prevention, Atlanta, Georgia, [17]Centers for Disease Control and Prevention, Atlanta, Georgia, [18]CDC, Atlanta, Georgia

Session: 272. Studies of Treatment and Prevention of Viral Disease
Saturday, October 5, 2019: 12:15 PM

Background: Respiratory viruses are associated with most asthma exacerbations (AEx) in children; however, the role of different viruses in AEx is unclear. We describe respiratory virus detections among pediatric inpatients with AEx (AEx-inpatients).

Methods: Through active, prospective surveillance at 7 US medical centers, we enrolled inpatients (<18 years) with acute respiratory illness (ARI) during November 1, 2015–June 30, 2016. We defined an AEx-inpatient as an inpatient with a principal admission or discharge diagnosis of asthma (ICD-10-CM, J45.xx). Mid-turbinate nasal and/or throat swabs were tested by molecular assays for influenza A or B, respiratory syncytial virus (RSV), parainfluenza virus 1–3, rhinovirus or enterovirus (RV/EV), human metapneumovirus and adenovirus. We assessed virus detections among AEx-inpatients throughout the surveillance period or by season (winter: